

An Essay
on
The Functions of the Cerebro-Spinal Axis

Respectfully submitted to the
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Functions of the Cerebro-Spinal Axis

The vital processes in the organic world do not essentially depend upon the presence of a Nervous System - in the embryo, in many of the lower animals, in the vegetable kingdom, these functions take place at certain intervals and governed by certain and definite laws. The Uterus will be called into contraction, after nine months when the foetus is able to live an independent life. Plants, stimulated by external influences, grow, bud and flourish in the summer and rest in the winter. But the higher organized animal acts and moves by internal influences generated in the Nervous System. And if we examine the Animal, especially

the vertebrate, at the first period of its formation, we shall find that the vertebral Column, first, makes its appearance for the protection of the Nervous Centres, a generator apparatus of the Animal force, constituting the essential part of the structure of the body.

Before I enter upon my subject, I beg leave to make a few general remarks upon the structure and properties of nerves, which will lead to a correct understanding of the matter.

A Nerve is an organ composed of fibres or fasciculi, formed of a white or medullary substance and a grey, or Cortical substance, connected together by a thin sheath or organ of protection — the Neurilema. Examined under the microscope it is found to be transparent, containing a semifluid substance in the centre, coagulable in the air and in water, design-

ated the substance of Schwann. A Ganglion is a collection of cellular nervous tissue, through which filaments of nervous cells pass and twist around - these prolongations becoming sometimes continuous with a nervous filament. - the Cells are characteristic of the grey substance; in the white there are only fibres. The Nerves are white, glossy, having a zig-zag appearance, like watered silk, as the nerve fibres are larger than the inelastic tissue, but parallel with each other. they do not branch, they do not innervate or ramify, they are continuous throughout, even from the brain to the foot. A filament is the ultimate fibre; so a Nerve is a bundle of filaments - and when we say it branches, it is because two or more of the filaments separate, as from the cervical forami-

na, forming a plexus. The inosculation, then, is apparent & not real. Sometimes filaments from one nerve pass on to another, and follow the parallel direction.

Nervous phenomena are different from those that take place outside of the body. Nervous force is the power by which nerves produce action in the organs - it is called irritability, and it can be excited by mental emotions, by mechanical means, by electricity etc, - even after death, - and continues for a certain length of time, being longer in the cold blooded animals than in the human subject or in birds. This irritability, acts upon fibres, contracting them and producing motion or sensation, and will only cease when the nerve has been severed or when it has ceased to endure

the stimulus, though in the latter instance, rest may restore it again - in the same manner as the disintegration produced in the tissues by their action is reproduced by rest.

There are certain substances which have the property of separating the irritability of the nerves, from that of the muscles: for example, Woorari, used by the Indians of Brazil to poison their arrows. This substance - though inert if taken in the stomach - when injected into the veins, its impression upon the nervous centres, destroys the power of motion and sensibility, and leaves an irritability in the muscles, which is undoubtedly of a different character from that of the nerves. The same is the case with Narcotics, as Opium, or accumulation of Car-

bonic acid gas in the system. Mr Longet, experimenting upon a dog, ^{dissected} ~~laid bare~~ the facial nerve and applied galvanism until the irritability was destroyed; then applied galvanism to the muscles, and found it existing in them.

Matteucci found the muscular current using the leg of a frog as a galvanoscope - passing the nerve of the galvanoscopic frog upon the incised muscles of the other leg produced contraction of the muscles, the same effect taking ^{place} through a succession of three or four legs. This current does not exist in life, but is the result of peculiar changes soon after death.

The nature of the force developed in the interior of the nerves is different from that of organic or formative force, from the

fact of the former being developed in an apparatus, especially adapted to it, while the latter is primary and universal, originating in the cell-germ of all organized beings and presiding over the molecular action, in its assumption of a type or form. By some it is supposed to be electrical - but all phenomena that are not known are not to be explained by electricity, as electricity is subject to fix and invariable laws. Electricity in order to be transmitted from one point to another requires to be insulated; the nerves are not insulated by any substance, there is neither an anatomical provision for the formation of the electrical circle. The Torpedo and the Gymnotus electricus have the power of discharging electricity generated in a separate and especial electrical

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apparatuses which they possess, as described
by J. Hunter & Mr Shaw, in the former
being disposed in the form of two perpendi-
cular hexagonal columns from the anterior ex-
tremity of the animal, to the cartilage which
divides the thorax from the abdomen, while in
the gymnotus the galvanic battery is dis-
posed lengthwise on the lower part of the
animal. - If the nerve of an animal is di-
vided and we apply one pole above and
the other below the cut, it is capable of trans-
mitting the electrical current and not the nerv-
ous current or force - the same thing occurs
when both extremities are separated and
connected with a wet thread; so that when
the nervous force ceases to act, electricity
continues

The correspondence between the

anatomical arrangement of the Cerebro-Spinal Axis, and the metaphysical arrangement of the attributes of man, suggests an orderly division of this Essay in the following manner:—first the anatomical and physiological description of the Cor da vertebralis, as being the instruments of mobility and sensibility; and secondly, the Encephalon proper, as being the seat of the perceptive and reasoning faculties.

The Spinal Cord, is a symmetrical organ enclosed in the vertebral Canal; is continuous with the brain and terminates in a rounded point at about the second lumbar vertebra. Like the brain it is surrounded by three continuous membranes, the duramater aracnoid and pia mater. By the anterior and posterior fissures it is divided into two lateral

halves, as we have a right and left hemisphere in the brain. It is composed of a grey substance interiorly and a white substance exteriorly - the latter having the form of two crescents united by a grey commissure. The Spinal nerves, 31 pairs in number, originate by a double root, divided by the membrana denticulata, from the lateral columns, each root in front of the peaks of grey matter and ramifying through the intercostal spaces. - The cervical nerves form the brachial plexuses, the lumbar and sacral nerves form the iliac plexuses for the pelvic region and lower extremities.

The nerves preside over the phenomena of sensation and motion although in some cases they may be independent from each other.

The office of the Spinal Cord may be considered in two ways: 1st as an independent centre of nervous action, and 2nd as an organ of communication between the brain and the nervous trunks.

The Spinal Cord as a nervous centre, or its reflex action. Whenever there is grey matter there are ganglia, and ganglia are nervous centres. A stimulus may be communicated from without inwards to the ganglion and from there reflected back in a motor impulse. Instances of this in man, are the instinctive attempts to support ourselves with our hands when we stumble or fall, and the constant tendency to preserve our equilibrium when asleep in an upright or a sitting posture, as often has happened to me travelling on horse back at night... In

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Animals, a decapitated frog, for instance, after the depressed irritability by the shock has returned, if left alone, will remain quiet in a sitting posture, but if we pinch its legs it immediately jumps away, as if to get rid of the annoyance. If the Cerebral nerve is divided on one side, the impressibility is lost, while it continues on the opposite side. Removing the internal organs and carrying away with them the ganglia of the Sympathetic system, still continues - but it ceases completely when the Spinal Cord is destroyed with a needle through the Spinal Canal.

Strychnia by its specific action stimulates unduly the Spinal Cord; Moorari, on the contrary, destroys the sensibility and no reflex action is produced. Strychnia does not produce convulsions - the convulsions

are produced by touch or contact: so in Tetanus, that is an increased morbid irritability of the Spinal Cord, it being necessary an external stimulus to produce the spasmodic contractions.

It might be thought that volition also resides in the spinal cord; but the animal does not give the least evidence of it, as it does not try to avoid danger - it would even jump into the fire, if turned in that direction. In paralysis or inflammation, sensibility is destroyed in the cord, without disturbing the integrity of volition and consciousness.

Though the brain can exert a direct controul, in some cases, over the reflex action, in most cases, as above demonstrated, it is independent of it. It is true,

that the act of respiration, an involuntary one, can be temporarily suspended or adapted to refined purposes as in elocution or singing, but it ~~will~~ be known, according to Dr Draper, when it is a simple action of the cord and when the brain participates in it:—"in the former no weariness or fatigue is ever experienced; in the latter it is; and perhaps even in this last involving involuntary muscular action, though the control is to be attributed to the brain the source of the force is in the Cord."

In the human subject the reflex action performs a triple object: - through the ~~motor~~ ^{motor} nerves influences the voluntary muscles; through the medium of the sympathetic ends in the involuntary muscles, producing evacuation of the bladder or rectum, vomiting

by peculiar sights or smells - and inversely, produces involuntary contraction of voluntary muscles, as the spasms of Cholera, convulsions by worms: - in the same way great emotions or mental impression produce involuntary contraction of voluntary muscles.

General functions of the Spinal Cord.

Alexander Walker, in 1809 suspected that in the anterior roots of the nerves proceeding from the Spinal Cord resided the power of motion, and in the posterior roots the power of sensation - and in 1812/13 Sir Charles Bell demonstrated that presumption by dividing the anterior and posterior roots of the nerves on living animals. But Mr Louget amplified the experiments of Bell, and by irritating the anterior roots, no sensibility, but muscular excitement was produced; and by dividing them loss of motion, or paralysis resulted: - irritat-

ing the posterior roots, produced pain, no muscular contraction; their division caused paralysis of sensibility. Advancing his experiments, Longet, concluded that the same phenomena take place in the anterior and posterior Columns of the Spinal Cord, as they are nothing but the sum of the bundles of fibres that compose the nerves.

Decussation of sensitive fibres. Since the times of Galen up to the present day, all physiologists have agreed, that the Columns of one side of the Spinal Cord are continuations of the opposite side of the brain, as in paralysis of one side of the body, ~~from~~ ^{the lesion} ~~injury~~ of the brain, is always found in the opposite side of that organ - and that the crossing of fibres took place on, or - above the Medulla oblongata, as dividing one lateral half of the cord below the first Cr -

neral vertebra, hemiplegia was produced, in the same way as paraplegia or total paralysis was the result when the whole of it was divided transversely. These views of Galen are recognized to day as true, only on the ground that he does not speak of sensibility at all, as he only refers to voluntary motion. Physicians, then, have taken it for granted that there is no crossing of action along the Spinal Cord, and Mr Longet, in a series of experiments, has been endeavouring to prove that the posterior columns of the Spinal Cord are the only channels by which sensitive impressions are conveyed to the brain. — But Dr. Ed. Brown Se-
guard in his valuable discovery, supported by experiments upon animals, and carefully collected pathological cases, has observed

that, in regard to Sensibility, exactly the reverse takes place, so that, an alteration or section of the Spinal cord on the right side, for example, produces a loss or a diminution of voluntary movements on the right side of the body, and a loss or diminution of sensibility on the left side - and vice versa. - As the grey matter, says Mr Longet, has no sensibility, it cannot be conductor of sensibility; and as the white matter is the only substance endowed with sensibility it evidently is the only conductor of sensitive impressions - But on examining the correctness of this statement we find that there are parts which having no sensibility, serve as organs of transmission of sensation to the brain. The following experiments, which I have had the pleasure of seeing Dr Brown

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Séguin perform, clearly illustrate this point
1st A section was made of the posterior
columns of the Spinal cord of a rabbit and
sensibility remained, and even ~~was~~ greater than
before.

2nd A division of the anterior columns,
or the rest with the gray matter, except the
posterior columns: in such a case, when sen-
sibility ought to be left, it is entirely lost.

That the decussation of the fibres of sen-
sation takes place all along, and between,
the columns of the the cord, may be proved
by dividing it longitudinally - when sensi-
bility totally disappears.

The Medulla oblongata - is a coni-
cal process of medullary structure from one
to one and half inches in length, situated
between the brain and the Spinal cord. Its

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limits above are generally considered to be on
the pons Varolii, but its structure extends,
through the pons, to the Crura cerebri, and
back towards the Cerebellum. There is no line
of demarcation between the medulla and
the Spinal Cord - Divided like the latter by
a middle commissure, presents the following
bodies, separated from each other by distinct
grooves: 1st Corpora pyramidalia or anter-
ior pyramids, 2^d Corpora Olivaria, situated
laterally, 3^d Corpora Restiformia, posteriorly,
and 4th posterior pyramids, thin and small
which lie within the restiform bodies on the
posterior aspect.

As a continuation of the Spinal cord
the anterior and posterior pyramids respective
ly convey motor and sensitive impressions.
Of the Olivary bodies little is known, their fi

has extend along the Crura of the brain and are lost in the tubercula quadrigemina and optic thalami. They are only found to exist in man and in the different species of Monkeys.

The Restiform bodies or respiratory ganglia give origin to the Pneumogastric or par-vagus, which is a complicated Nerve, both of Sensation and motion, and to some of the roots of the glossopharyngeal. The posterior pyramids are rather indistinctly marked - and from ^{their} grey nuclei raises the Auditory nerve.

The physiological importance of the Medulla oblongata is derived, in some measure, from the fact of the Pneumogastric Nerve having its origin in the restiform bodies, and is considered, in regard to its reflex action, as an automatic organ, acting by a mild excitement, which we are not conscious of, on

on account of its habitual and permanent repetition, but the moment that respiration is stopped we become conscious of a disagreeable sensation - the desire of breathing. (besoin de respirer). The air of the lungs, charged with Carbonic acid gas, probably produces its impression upon the pneumogastric nerve and thence it is communicated to the respiratory muscles by the motor nerves. In asphyxia the dashing of cold water, the application of electricity or of an incandescent iron upon the chest, converts the reflex action into violent respiratory muscular action - The Garrote, Spanish instrument of execution, is a screw which passing through the foramen magnum, destroys the respiratory ganglia and reaches sometimes the tuber annular, destroying consciousness.

ness and sensation, together, with the motor tracks. The dislocation of vertebra dentata in accidents or in hanging, by effect of pressure, produces the same result.

Physiologists assert that the Medulla oblongata is the only centre for respiration, limiting the power to a minute "vital Spot" - Such a theory being based upon the ground that the brain, the Cerebellum & the Pons Varoli, may be cut above, and the spinal cord below, that point, and respiration continues. But if that point is concerned in respiration and in animal life is from one to one and half lines in diameter, when a section is ^{made} near it, we find that, that very part cannot be employed in that kind of action, as there is at least a line or two below and above, whose vessels ~~are~~ more or less injured by the cut and lose their

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vitality: therefore the limit is higher or lower.
Dr Brown Sequard refers several interesting cases, not all alike, in which the Medulla has been more or less destroyed, including that part, and life has not ceased. Among them was that of a woman in whom a morbid growth had thickened the foramen magnum reducing the Canal for the medulla to one and a half lines, and extending for one and a half inches, without respiration having been disturbed, or even feeling inconvenience of any kind - as a few fibres between nervous centres are enough to convey impressions. - Cancerous tubercles destroy the medulla without disturbance in the respiratory movements -

One more conclusive fact in opposition to the above assertion: The head of a pigeon being cut below the medulla, having pre-

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viciously introduced into the trachea a curved glass tube, in the shape of the letter U, with some water in it, the animal shows efforts at respiration in rhythmical movements, manifested also by the chest and wings.

The Medula oblongata has more to do with respiration, ^{than any other organ,} as the paravagus arises from it. Notwithstanding, the paravagus may be divided and respiration still continue, though weak, as there are other nerves connected with this process; so that, when death ensues from injuries to the medula, it is not from the lesion of the so called "vital spot". Irritation of the vital knot, through the medium of the paravagus, stops momentarily by the action of the heart, but this very knot has been repeatedly removed by Drs Séguard and Dalton without killing.

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the animal. Besides Professor Dalton has discovered, though not yet explained in books, that a section of the Spinal accessory Nerve, which arises from the 4th and 5th cervical nerves, and accompanies the larynx in part of its course, stops immediately the action of the glottis and consequently respiration ceases. Hence the true vital spot will be found upon the Spinal accessory nerve.

The Brain.

Similar to the Spinal Cord, the Brain is a collection of ganglia, which, arranged in a hemispherical mass, is enclosed in the Cavity of the Cranium. By simply following its fibres it would not be difficult to find

which are its motor and sensitive parts. It consists above of two anterior, middle and posterior lobes, fissure of Sylvius or lower part of lateral lobes, Tuber Amygd. or Pons Varolii and the two lobes of the Cerebellum—below: Olfactory ganglia, Tubercula quadrigemina, Optic thalami, Corpora Striata etc. It is a structure of an extreme complexity and most of its functions are yet either unknown or involved in theories.

The above mentioned organs are the most important in a physiological point of view. The ganglia and nerves of special senses and the cranial nerves, originating from the base of the brain and medulla oblongata, constitute a set by themselves performing peculiar functions and consequently require a separate attention; and if I allude to some of them here, it is, in their relation

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with the organs that I describe.

The Hemispheres, Superposed to the cerebral apparatus, consist of white and grey nervous matter, arranged in folds or convolutions and invested by the membranes, arachnoid, pia mater and dura mater. Neither the power of Motion nor Sensibility reside either in the white or in the Grey Substances, being insensible to all appearances: all kinds of Stimuli, acids and alkalis have been applied in animals & men, in operations and experiments. This is so, as the anterior and posterior Columns of the Spinal Cord are the only Capable of irritability or sensation, but they being merely organs of transmission and not of origination. The Hemispheres are organs of origination and the changes of volition, perception etc, are not to be artificially imitated. If the whole

hemispherical mass is removed, the power of volition and perception remain and also the power of special senses. In animals where the hemispheres have been excised, they hear and see, but remain, if not excited, in a state of indifference and apparent insensibility - the animal loses judgement, memory etc, that is to say, the powers of the mind, leading us to the conclusion that the intellectual faculties reside in the hemispheres, although independent of an organic action. The brains of the lower orders of animals, less developed in proportion to their perceptions, prove the same fact.

In different races of men, in congenital idiots, for example, the size of the Cranial Cavities often show the amount of intelligence that they possess. The size of the heads of such men as Newton, Cuvier, Benjamin Franklin and Daniel

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Webster, stand as an evidence of the truth of the former statement; a proof of the latter, will be found in the heads of the Aztec children, exhibited in this Country a few years ago - their want of ingenuity corresponded so well with the contracted proportions of their skulls, that they hardly had sufficient talent to masticate their food when put into their mouths.

Bichat supported the idea, and not without foundation, that besides Size Symmetry in proportion was also necessary to the existence of talent; but he did not suspect that his own head was an exception to the rule he tried to lay down, for, Curiously enough, after his death one of the hemispheres was found to be considerable larger than the other - and he was the star of his age!

Phrenology. Doctor Gall and his follow-

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ers, noticing the above facts, pretended to elevate
Phrenology to the rank of a science, showing the
correspondence of the Spirit with its immediate
nervous organ, the Encephalon. As in the bo-
dily organs, wherever there is exercise there
is developement, he concluded that he might
ascertain the locality of all the different faculties
of the Soul, and their respective energies, by di-
viding the brain into several regions, and that
each of these parts should be developped in pro-
portion to its prominence in the individual. This
doctrine excited a great deal of attention at
one time, but at present, a belief in phrenological
dogmas is repudiated by scientific men; although
the system itself is a most ingenious one, and
contributed directly to unfold to us the phy-
siology of the brain - and consequently to illus-
trate its relations with Psychology and Moral Science.

A curious anecdote is related by Macilwain
in his Memoirs of Doctor Abernethy, which I
will be allowed to quote: Dr Spurzheim while
in England being occupied in the promulgation
of his theories frequented Abernethy's
friendship; and one day being asked
by the latter "half seriously half humor
ously": "Well, Doctor, where do you place the
organ of Common Sense?" Spurzheim's reply
certainly sustained the coincidence of phre
nological deductions with those of experience,
"There is no organ," said he "for Common
sense, but it depends on the equilibrium of the
other organs."— Two facts, however, have not,
and probably never will, be demonstrated; that
to say, that different intellectual faculties
reside in different parts of the Brain, nor
what are the parts of the Brain occupied

by special intellectual faculties. Another objection is that examinations are made from the outside, but internal tumors, growths and aneurisms will make the bones of the skull give way, if they are not naturally unequal - and in these instances, great mistakes could be made. Also the convolutions are not equally developed, some are deeper than others; the grey substance, which is the most important, may be thinner or thicker - the upper surface of the cerebellum or the fissure of Sylvius, cannot be felt from the exterior of the cranium: in a word, the whole of the base of the brain will, of necessity, escape our observation.

If from experience we should pretend to arrive at right conclusions, we would require to know perfectly, the peculiar mental quali-

ties of a certain number of individuals, in all their phases of character, as modified by circumstances and situations in life, and could that be realisable in one man's period of existence? Who would be able to explore the unfathomable recesses of the human heart? He that would have the pride to boast of knowing another man's character, would have to succumb, at last, to acknowledge that he did not know himself - we may know of others, perhaps, enough to retain our social position - to avoid unpleasant collisions. Hence, as a Science, Phrenology must forever be imperfect.

The functional activity of the Brain depends upon its proper supply of arterial blood. The circulation of blood is effected in this organ, by means of the internal Carotids and the two

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vertebral arteries, which anastomose freely
in the Circle of Willis - A deficiency of
arterial blood, on the contrary, or an accu-
mulation of venous blood, leaves it in a comatose
condition. It is very well known that ^adetermina-
tion of blood, induced by an accelerated circula-
tion, produces exhilarating effects, and ar-
ouses into action qualities of the mind
and propensities, which habit and educa-
tion would otherwise successfully conceal;
such are the buoyancy of spirits, oratori-
cal display or beligerent disposition, ex-
hibited by those who inhale the protoxide
of nitrogen or laughing gas, or use wine
or alcoholic liquors; but no sooner a suffi-
cient amount of Carbonic acid is genera-
ted in the blood, and the lungs no longer
being able to expell it, these phenomena

are succeeded by a corresponding depression, giddiness and insensibility.

Though the Brain is a double organ, acting in harmony in all its functions, when in a normal state, still, in many cases, there seems to be a deviation of this harmony, which can only be explained by admitting the capability of independent action of each hemisphere, called by Dr Wigan duality of mind. Their operation in such cases may be alternately, while one of them is at rest or temporarily disturbed, or both in different directions. As an illustration may be cited the apparent perfect performances of mental functions in some diseases or injuries of one side of the brain - that state called absence of mind - the unsuccessful attempt to profit from the reading of a book in certain

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cases, or listening to a lecture, the mind
being occupied with a different subject.

In Cattle building, too, one of the hemispheres
seems quietly to contemplate the fanciful
wanderings of the other.

The Cerebellum, although it is
smaller than the Cerebrum it does not differ
essentially from it, in the character of its Convo-
lutions - they are deeper and more compli-
cated, notwithstanding, and are termed arbor
vita, on both sides, from their resemblance to a tree.

Many theories have been established in
regard to the functions of the Cerebellum. It
was believed by some, to be the seat of sexual
instinct and by other the seat of power to
move forwards, - and the optic thalami
on the contrary, to direct movements back-
ward - Gall established it to be that of

amativeness or sexual instinct, as it increases, in size at the age of puberty; but subsequent observations have proved that it does not keep pace with the physical development of the animal or the individual. In Mares it is greater than in horses and in Stallions greater than in the other two; and the French physiologists find the difference in those animals that are devoid of sexual instinct, and that it is the size of the Cerebrum that predominates in the Stallion. The next theory of Mr. Florens, is that of being the power of coordinating the different contractions of Muscles - all our movements requiring a certain degree of contraction balanced by a corresponding relaxation of other muscles - and this is the most probable, as whenever in the lower animals, as in birds, the cerebellum

has been destroyed or injured, a debility ensues, and the movements become irregular, resembling cases of intoxication. There are however one or two facts which do not correspond with this assertion. Audouin being occupied at one time, in making observations upon diseases and injuries of the brain observed that no facts he obtained corroborated Flourens' assertion. Other facts, from comparative anatomy, prove that the development of the Cerebellum does not correspond with the complication of the animal movements.

The movements of the Frog are more complicated than those of the Fish; yet, the Cerebellum of the latter is comparatively larger than that of the former. In the development of the Tadpole into a frog, although the other nerves increase in size, the Cerebellum does not change. The cetacea, including whales and seals, being the

connecting link between the fishes and mammals,
are superior in organization to all other fishes,
and yet, possess proportionately smaller cerebelli.

Let us now proceed to consider the other
organs and their physiology.

Corpora Striata and Optic thalami, are
the superior ganglia of the Cerebrum - the former
are so called on account of being composed of
grey matter striated with white; the Optic
thalami were supposed by old anatomists
to be the centre of origin of the optic nerve. The
office of these two ganglia is not ascertained.
From their connection with the nerves, both of
special and general sense, they have been sup-
posed to be sensory ganglia, a vague name,
and the more so, if we observe that both have
been excited without disturbance to the powers of
motion or sensibility - we cannot come at exact

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conclusions from their removal, as the hemisphere,
will have to be separated first.

Tubercula quadragemina, are called the
Optic tubercles or ganglia of sight. The Optic
nerve originates from them, and from part of the
Optic thalami. They are covered by the middle
lobes of the cerebrum and by the Crus cerebri.

The retina and optic nerves, being entirely sensi-
tive nerves, communicate impressions from without
inwards - the retina perceives nothing but light
and darkness; the modifications of perspective
and color are produced by the peculiar appara-
tus of the eye. The power of sight is destroyed by
attacking the Tubercula quadragemina through
the fissure of Sylvius; and irritation of one
of them affects more or less the sight of the
other eye, owing to the Crossing of some of the
fibres of the Optic nerve in the Chiasma.

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The Pons Varolii or tuber annulari,
is the commissure to the two lobes of the Cerebrum,
and ganglion of continuous sensation and volun-
tary action. The motor and sensitive tracks of
fibres of the Spinal Cord, pass through the pons,
until they reach the Cerebrum, the point where
their impressions are converted into percep-
tions and sensations. When the pons is destroy-
ed the power of sensation, and the power of origin-
ating voluntary impulses, are destroyed too.
The section of one side or obstruction by tumors,
gives rise to convulsions or epileptic fits.

There are, then, three kinds of reflex
actions: one residing in the Spinal Cord without
sensation etc - one in the tuber annulari, with
sensation, volition and consciousness, but absence
of reasoning - and the other in the Cerebrum, with
volition, sensation, consciousness and reasoning.

I shall conclude this rapid review of the anatomy & functions of the Cerebro spinal Axis, by alluding once more to the nerve force - not as to whether it is electrical or its allied, as it has not been satisfactorily determined. Is the nerve force which is operative in all the mechanical acts of the animal economy, of the same character and nature with the dynamic agent employed in sensation and reasoning? - That it is so, may be inferred when we observe that a man who has been physically fatigued, by riding for instance, becomes prostrated and unable to resume other kind of Corporal exercise. Men that have undergone great physical exertion lose part of their mental powers - conversely, by excessive mental activity or deprivation of sleep we become exhausted, we lose our strength, and as a consequence, our health is impaired. Be-

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sides, when we receive great mental emotions,
our physical and mental powers are either
weakened or affected. In fact, the relation
between the mental and Corporal strength can
not be better demonstrated than by the well
known afforism, which serves us as a com-
pass in the treatment of disease:

Mens Sana, in Corpore Sano.

John R Goodman,

Philadelphia January 1857.